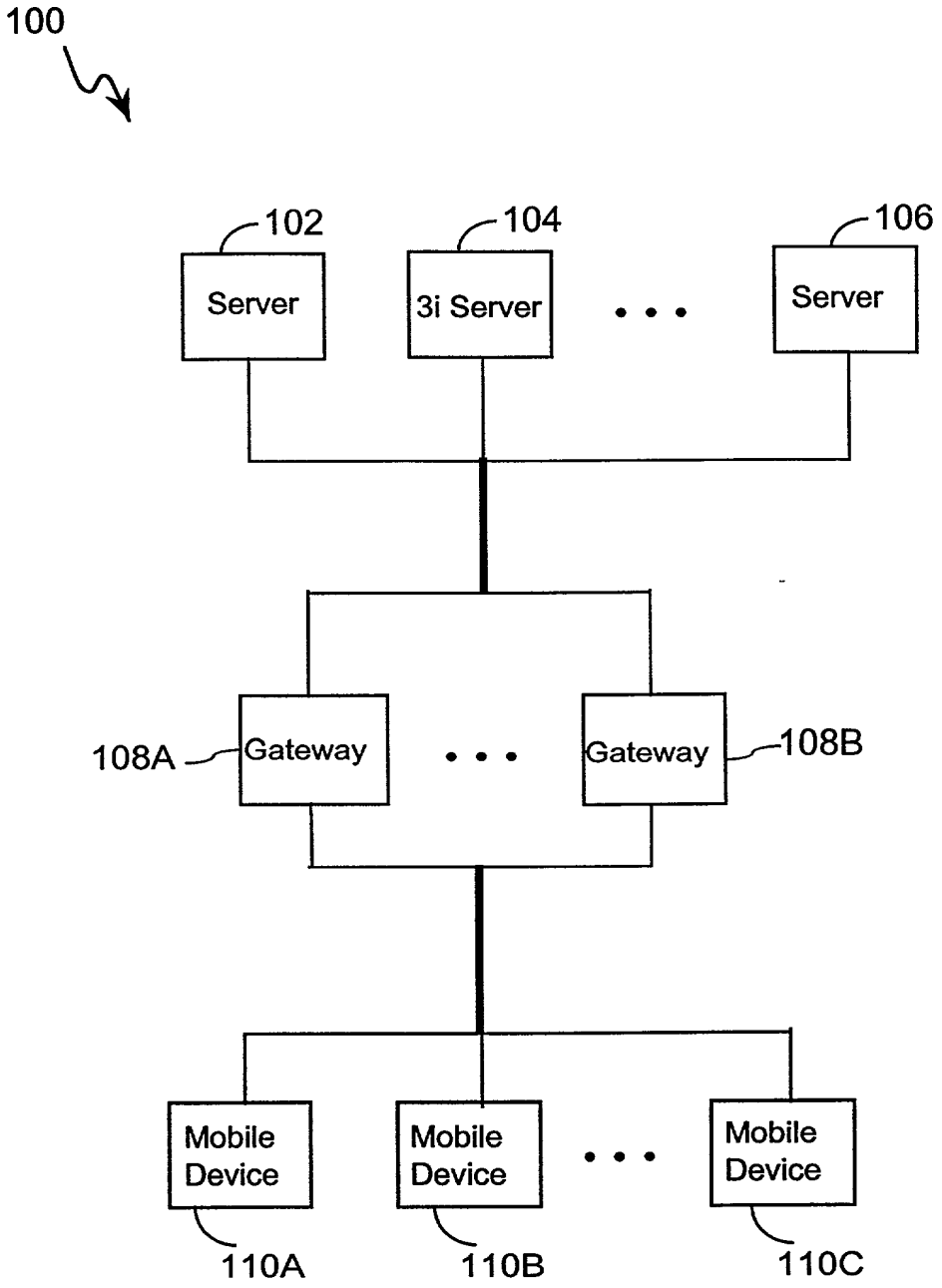
100
102
104
106
Server
3i Server
Server
108A
Gateway
Gateway
108B
Mobile Device
Mobile Device
Mobile Device
110A
110B
110C

FIG. 1

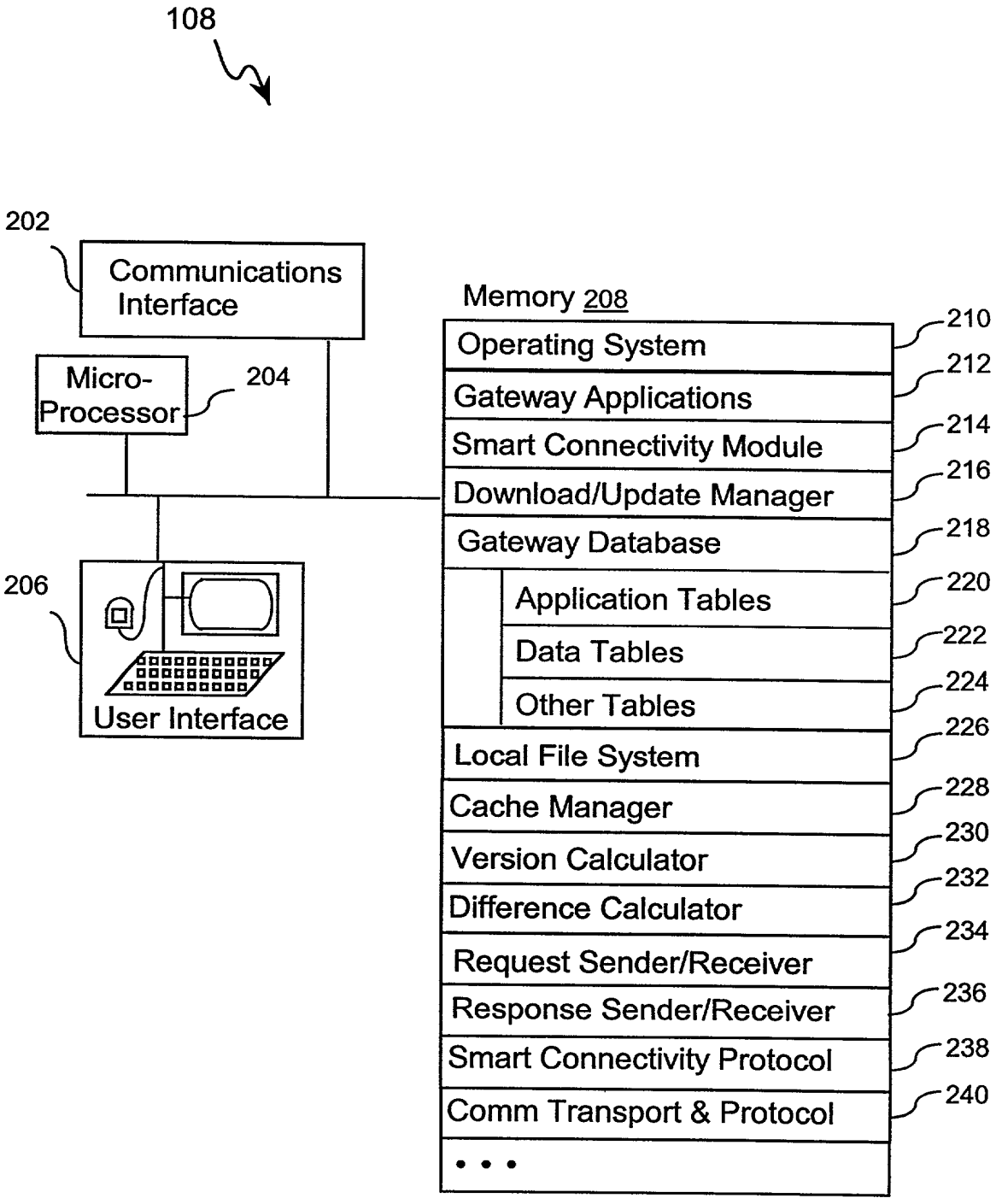
108
202
Communications Interface
Micro-Processor
204
206
User Interface
Memory 208
Operating System
210
Gateway Applications
212
Smart Connectivity Module
214
Download/Update Manager
216
Gateway Database
218
Application Tables
220
Data Tables
222
Other Tables
224
Local File System
226
Cache Manager
228
Version Calculator
230
Difference Calculator
232
Request Sender/Receiver
234
Response Sender/Receiver
236
Smart Connectivity Protocol
238
Comm Transport & Protocol
240
• • •

FIG. 2

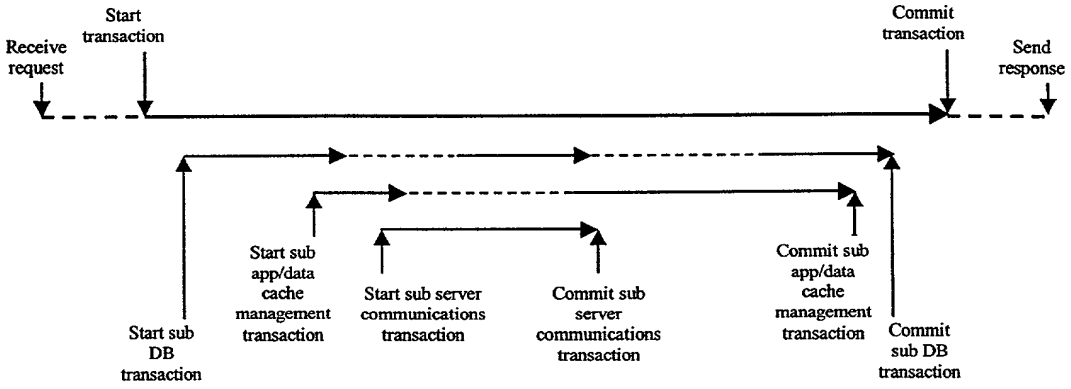
Receive request
Start transaction
Commit transaction
Send response
Start sub DB transaction
Start sub app/data cache management transaction
Start sub server communications transaction
Commit sub server communications transaction
Commit sub app/data cache management transaction
Commit sub DB transaction

FIG. 3

Application Identification Table

Column	Data Type	Length	Description
appURL	String of unicode characters	Variable length	Application URL, comprising protocol name, host address, path, and application name. Example: http://www.mysite.com/asp/myapp.
appID	Unsigned integer	4 bytes	Unique identifier for the corresponding application URL.

FIG. 4

Data Identification Table

Column	Data Type	Length	Description
dataURL	String of unicode characters	Variable length	Data URL, comprising protocol name, host address, path, and data file name or a database query. Example: http://www.mysite.com/data/mydata.
dataID	Unsigned integer	4 bytes	Unique identifier for the corresponding data URL.

FIG. 5

Application Registration Table

Column	Data Type	Length	Description
appID	Unsigned integer	4 bytes	App URL, comprising protocol name, host address, path, and app name. Example: http://www.mysite.com/asp/app/myapp.
appVer	Byte array	16 bytes	Application version. It will be automatically filled in by the gateway.
flagSet	Unsigned integer	1 byte	Flag: • If the 1st bit is on, the corresponding application is permitted for caching; • The 2nd bit to 7th bit are reserved; • If the 8th bit is on, the corresponding application is disabled from user access.
domName	String	Variable length	The domain name of the corresponding application URL.
procolType	String	Variable length	The protocol type of the corresponding application URL.
virtualPath	String	Variable length	The virtual path of the corresponding application URL.
portNo	Unsigned integer	2 bytes	The port number of the corresponding application URL. 0 indicates using the standard port number for the corresponding protocol type.

FIG. 6

Compression Methods Table

Column	Data Type	Length	Description
compName	String	Variable length	Data compression method name.
compID	Unsigned integer	1 byte	Unique identifier for the corresponding data compression method ID.

FIG. 7

Compatible (3i) Server Registration Table

Column	Data Type	Length	Description
domName	String	Variable length	Compatible server domain name.
owner	String	Variable length	Owner of the corresponding compatible server.
patchVer	Byte array	3 bytes	The server patch version installed on the corresponding compatible server. It is encoded as follows: • The 1st byte indicates the major version; • The 2nd byte indicates the minor version; • The 3rd byte indicates the revision number.

FIG. 8

Session Management Table

Column	Data Type	Length	Description
sessionID	Unsigned integer	4 bytes	Session identifier.
subID	String	Variable length	The identifier of the subscriber who caused to create the corresponding session.
procolVer	Byte array	3 bytes	The protocol version used in the corresponding session. It is encoded as follows: • The 1st byte indicates the major version; • The 2nd byte indicates the minor version; • The 3rd byte indicates the revision number.
compID	Unsigned integer	1 byte	The identifier of the data compression method used in the corresponding session.
optionProp	Binary stream	Variable length	Optional properties of the corresponding session. It is encode as follows: • The 1st byte is a flag to indicate which optional properties are defined; • All the following bytes are the values of defined properties;
timeStamp	Unsigned integer	4 bytes	The starting time stamp of the corresponding session.
TTL	Unsigned integer	4 bytes	The designated session lifetime in second.

FIG. 9

Application Download/Update Histories Table

Column	Data Type	Length	Description
appID	Unsigned integer	4 bytes	Application identifier.
appSize	Unsigned integer	4 bytes	Size in byte of the corresponding application.
nDownload	Unsigned integer	4 bytes	Number of downloads of the corresponding application by all local mobile devices.
nUpdate	Unsigned integer	4 bytes	Number of updates on the corresponding application by all local mobile devices.
updateRate	Unsigned integer	1 byte	Average update rate (1-100 in percentage) for the *nUpdate* updates on the corresponding application by all local mobile devices.
timeStamp	Unsigned integer	4 bytes	The time stamp of the last download of or update on the corresponding application by a mobile devices, based on the corresponding gateway's local clock.

FIG. 10

Data Download/Update Histories Table

Column	Data Type	Length	Description
dataID	Unsigned integer	4 bytes	Data identifier.
dataSize	Unsigned integer	4 bytes	Size in byte of corresponding data.
nDownload	Unsigned integer	4 bytes	Number of data downloads of the corresponding data by all local mobile devices.
nUpdate	Unsigned integer	4 bytes	Number of updates on the corresponding data by all the local mobile devices.
updateRate	Unsigned integer	1 byte	Average update rate (1-100 in percentage) for the *nUpdate* updates on the corresponding data by all the local mobile devices.
timeStamp	Unsigned integer	4 bytes	The time stamp of the last download of or update on the corresponding data by a mobile device, based on the corresponding gateway's local clock.

FIG. 11

Application Storage Table

Column	Data Type	Length	Description
appID	Unsigned integer	2 bytes	Application identifier associated with the corresponding application URL.
nFile	unsigned integer	1 byte	Number of files included in the corresponding application.
fNames	Array of strings of unicode characters	Variable length	Array of the names of all files included in the corresponding application.
appVer	Byte array	16 bytes	Application version. It will be filled in by the gateway.
fVers	Array of byte array	Variable length	Array of the version information of all files included in the corresponding application.
root	String of unicode characters	Variable length	Root directory in the local storage where the corresponding application is cached.
nextRel	Unsigned interger	4 bytes	Next release time of the corresponding application, based on the corresponding origin application server's local clock.
lang	Unsigned integer	1 byte	Code, indicating the type of computer language used to write the corresponding application.
flagSet	Unsigned integer	1 byte	Flag: • The 1st bit to 7th bit are reserved; • If the 8th bit is on, the corresponding application is out-of-date.
nUpdate	Unsigned integer	2 byte	Number of updates on the corresponding application by the corresponding gateway since the application has been cached.
updateRate	Unsigned integer	1 byte	Average update rate (1-100 in percentage) for the *nUpdate* updates on the corresponding application by the corresponding gateway.
CBI	Unsigned integer	4 bytes	Cache Benefit Index.
updateItvl	Unsigned integer	4 bytes	The guessed application update interval.
LastUpdate	Unsigned Integer	4 bytes	The time stamp of last application update.

FIG. 12

Data Storage Table

Column	Data Type	Length	Description
dataID	Unsigned integer	2 bytes	Data Identifier of the corresponding data URL.
root	String of unicode characters	Variable length	Root directory in the local storage where the corresponding data is stored.
flagSet	Unsigned integer	1 byte	Flag: • If the 1st bit is on, the corresponding application is updated by at least one 3i mobile terminal. • The 2nd bit to 7th bit are reserved; • If the 8th bit is on, the corresponding application is out-of-date.
DataVer	Byte array	16 bytes	Version information of the corresponding execution of data.
nUpdate	Unsigned integer	2 byte	Number of updates on the corresponding data.
updateRt	Unsigned integer	1 byte	Average update rate (1-100 in percentage) for the *nUpdate* updates on the corresponding data.
CBI	unsigned integer	4 bytes	Cache Benefit Index.
updateItvl	Unsigned integer	4 bytes	The guessed data update interval.
lastUpdate	Unsigned integer	4 bytes	The time stamp of last data update.

FIG. 13

Broadcast Table

Column	Data Type	Length	Description
subID	String	Variable length	Subscriber identifier
appID	Unsigned integer	4 bytes	The identifier of the application on which the corresponding broadcast message was received by the corresponding gateway.
appVer	Byte array	16 bytes	The version information of the broadcast application.

FIG. 14

Configuration Table

Column	Data Type	Length	Description
Name	String of Unicode characters	Vari-able length	Parameter name. ***MAX_APP_CACHE_SIZE:*** *The maximum memory size in byte for the intelligent application caching.* ***MAX_DAT_CACHE_SIZE:*** *The maximum memory size in byte for the intelligent data caching.* ***FREE_APP_MEM_SIZE:*** *The memory size in byte that is free for application caching. It is MAX_APP_CACHE_SIZE initially.* ***FREE_DATA_MEM_SIZE:*** *The memory size in byte that is free for data caching. It is MAX_DATA_CACHE_SIZE initially* ***EFFECT_PERIOD:*** *The amount of time application and data records can be stored in the gateway DB since the last execution of or access on the corresponding applications or data.* ***MAX_DB_CONNECTS:*** *The maximum number of DB connections.* ***MAX_COMM_CONNECTS:*** *The maximum number of wireless communications connections.* ***CM_CHECH_INT:*** *The interval for periodic check on application/data update.* ***DEFAULT_UPDATE_TM_INT:*** *The default (initial) update interval for an application/data cached in a gateway.* ***UPDATE_TM_PERCENT:*** *The percentage of the actual application or data update interval against the guessed update interval of the corresponding application or data.* ***UPDATE_TM_WEIGHT:*** *The weight of the last actual application or data update interval against the previous guessed update interval of the corresponding application or data.* ***SCHE_RETRY_TM:*** *The retry interval after an application update schedule expires and before its update is actually confirmed.* ***USER_EVENT_PRIO:*** *The priority of a gateway-to-server request driven by a user event.* ***BRD_SCHE_PRIO:*** *The priority of a gateway-to-server request caused by application update schedule expiration or a server-to-gateway broadcast message.* ***GUESSED_UPDATE_PRIO:*** *The priority of a gateway-to-server request caused by estimated application or data update interval.* ***PASSWD_RETRY_NO:*** *The permitted number of retries of for a password matching failure.* ***MAX_IGNORE_NO:*** *The maximum continuous ignorance number on applications.* ***APP_CACHE_ROOT:*** *The top-level directory where applications can be cached.* ***DATA_CACHE_ROOT:*** *The top-level directory where data can be cached.* ***SESSION_TTL:*** *The time-to-live of a newly created logical session, during which, the session may be reused.* ***LAST_SESSION_ID:*** *The last assigned wireless communication session identifier. It will be 0 initially.* ***VERSION_TTL:*** *The time-to-live of the difference files associated to the oldest version of an application cached in the gateway.* ***LAST_APP_ID:*** *The last assigned application identifier. It will be 0 initially.* ***LAST_DATA_ID:*** *The last assigned data identifier. It will be 0 initially.* ***LAST_APP_KEY_ID:*** *The last assigned application-key pair identifier. It will be 0 initially.* ***DEFAULT_CHECK_TM:*** *The initial (default) amount of time allowed between two application or data status check requests.* ***W_COMM_TIMEOUT:*** *The timeout time for a wireless communication message.* ***I_COMM_TIMEOUT:*** *The timeout time for an Internet communication message.* ***W_COMM_RETRY_NO:*** *The permitted number of retries for a wireless communication failure.* ***I_COMM_RETRY_NO:*** *The permitted number of retries for an Internet communication failure.*
Value	String of unicode characters	Vari-able length	Parameter value. It needs to be reinterpreted for different parameter names.

FIG. 15

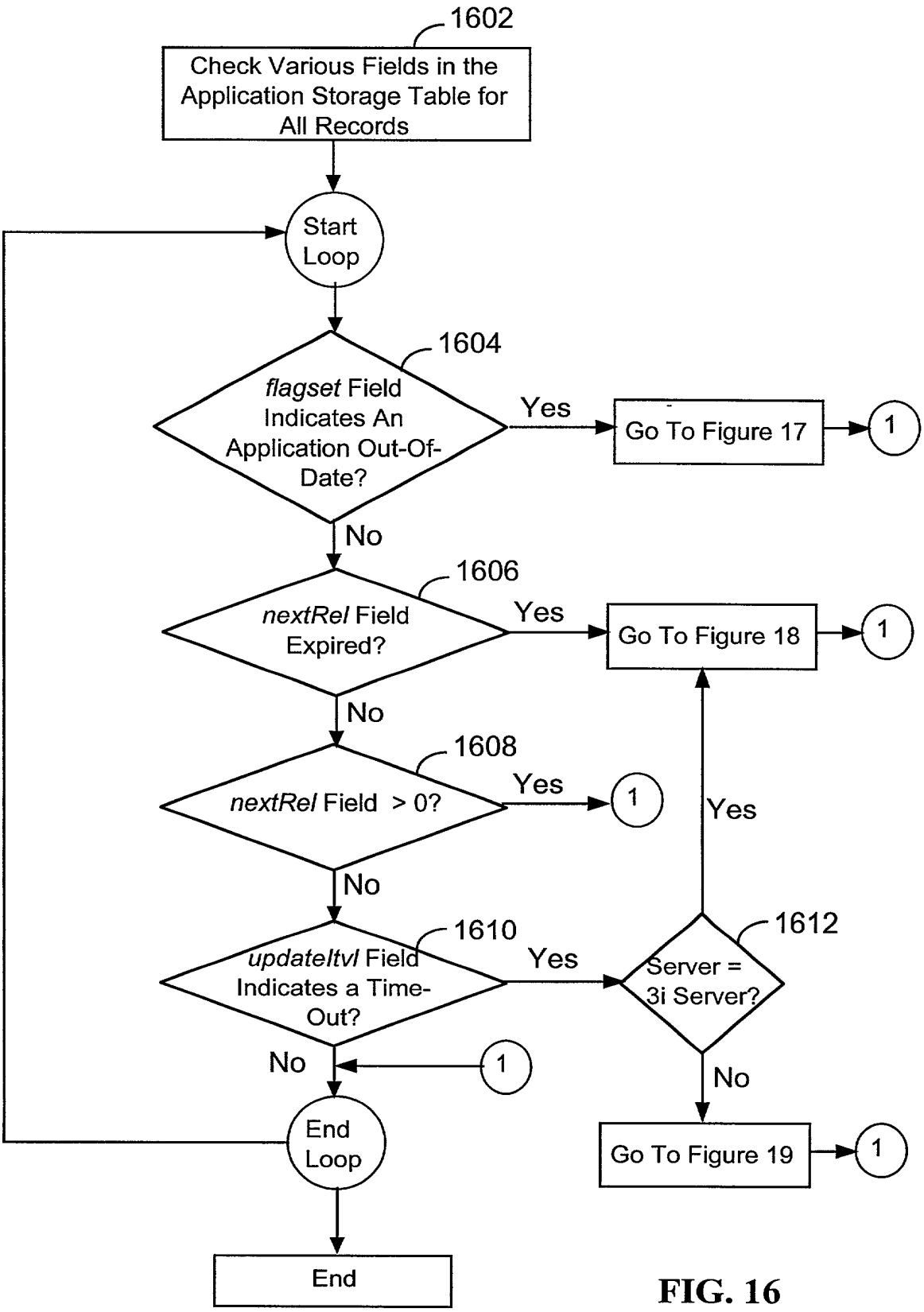
1602
Check Various Fields in the Application Storage Table for All Records
Start Loop
1604
flagset Field Indicates An Application Out-Of-Date?
Yes
Go To Figure 17
1
No
1606
nextRel Field Expired?
Yes
Go To Figure 18
1
No
1608
nextRel Field > 0?
Yes
1
No
1610
updateItvl Field Indicates a Time-Out?
Yes
1612
Server = 3i Server?
Yes
No
1
No
End Loop
Go To Figure 19
1
End

FIG. 16

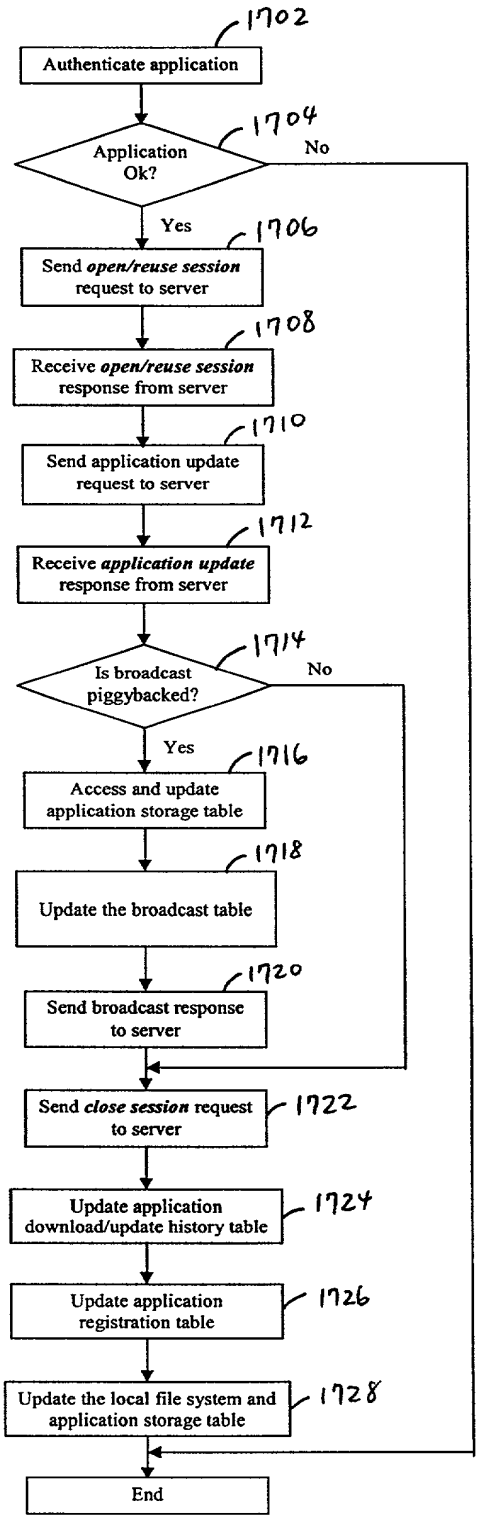
1702
Authenticate application
1704
Application Ok?
No
Yes
1706
Send open/reuse session request to server
1708
Receive open/reuse session response from server
1710
Send application update request to server
1712
Receive application update response from server
1714
Is broadcast piggybacked?
No
Yes
1716
Access and update application storage table
1718
Update the broadcast table
1720
Send broadcast response to server
1722
Send close session request to server
1724
Update application download/update history table
1726
Update application registration table
1728
Update the local file system and application storage table
End

FIG. 17

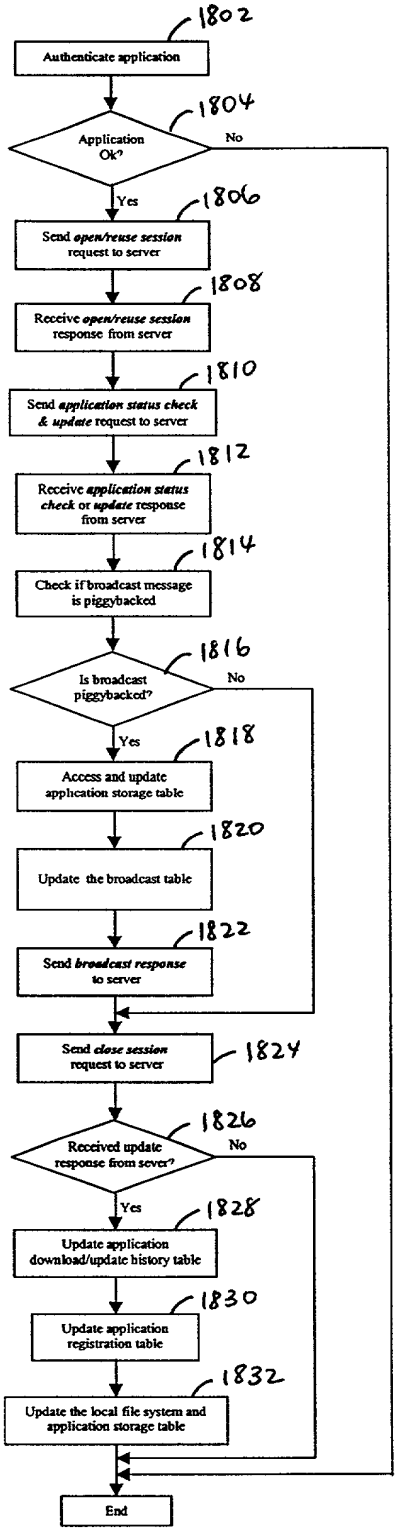
1802
Authenticate application
1804
Application Ok?
No
Yes
1806
Send open/reuse session request to server
1808
Receive open/reuse session response from server
1810
Send application status check & update request to server
1812
Receive application status check or update response from server
1814
Check if broadcast message is piggybacked
1816
Is broadcast piggybacked?
No
Yes
1818
Access and update application storage table
1820
Update the broadcast table
1822
Send broadcast response to server
Send close session request to server
1824
1826
Received update response from sever?
No
Yes
1828
Update application download/update history table
1830
Update application registration table
1832
Update the local file system and application storage table
End

FIG. 18

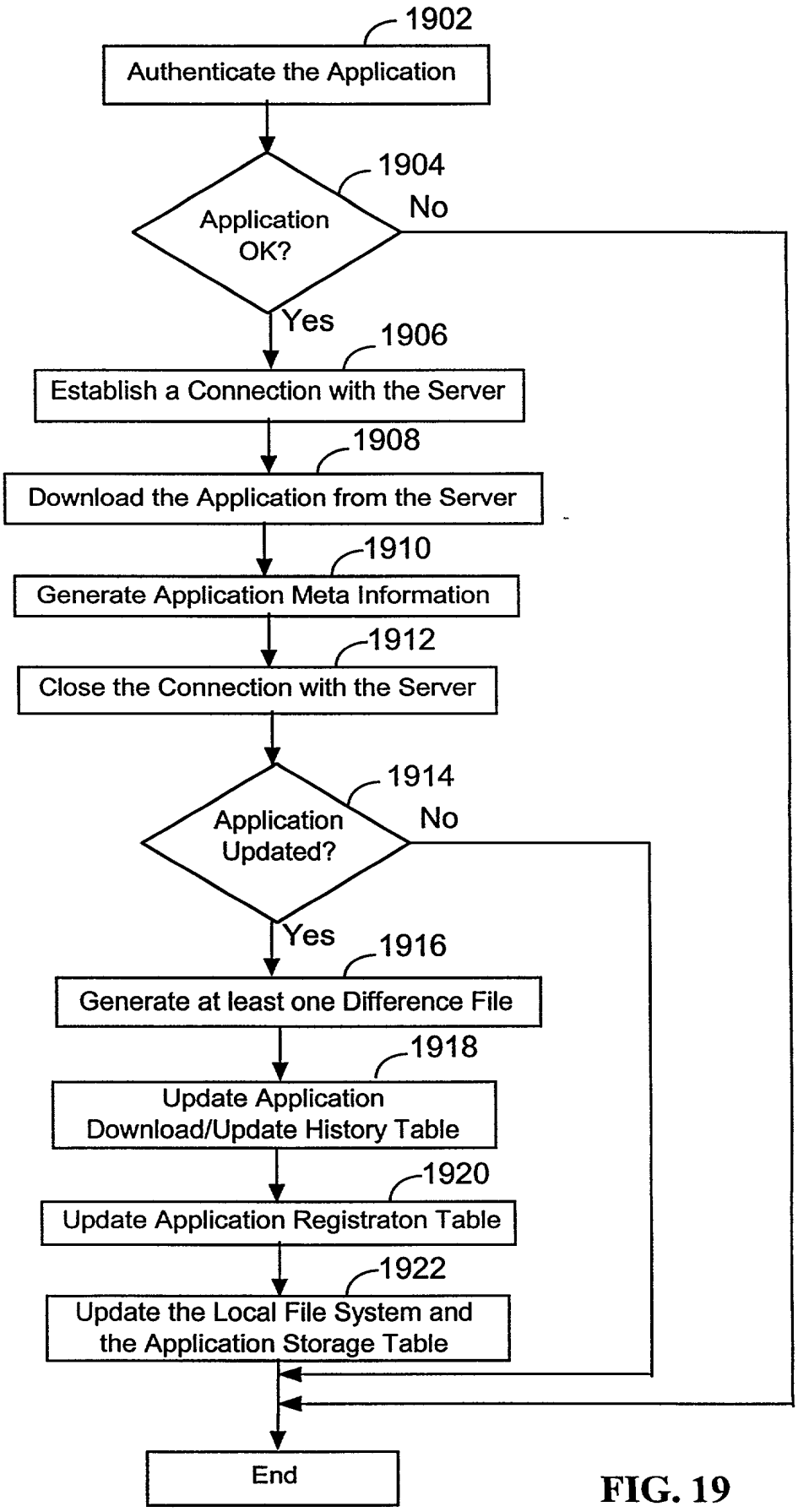
1902
Authenticate the Application
1904
Application OK?
No
Yes
1906
Establish a Connection with the Server
1908
Download the Application from the Server
1910
Generate Application Meta Information
1912
Close the Connection with the Server
1914
Application Updated?
No
Yes
1916
Generate at least one Difference File
1918
Update Application Download/Update History Table
1920
Update Application Registraton Table
1922
Update the Local File System and the Application Storage Table
End

FIG. 19

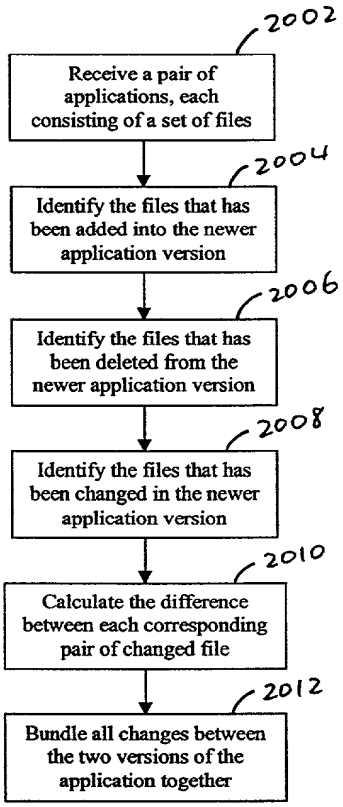
2002
Receive a pair of applications, each consisting of a set of files
2004
Identify the files that has been added into the newer application version
2006
Identify the files that has been deleted from the newer application version
2008
Identify the files that has been changed in the newer application version
2010
Calculate the difference between each corresponding pair of changed file
2012
Bundle all changes between the two versions of the application together

FIG. 20

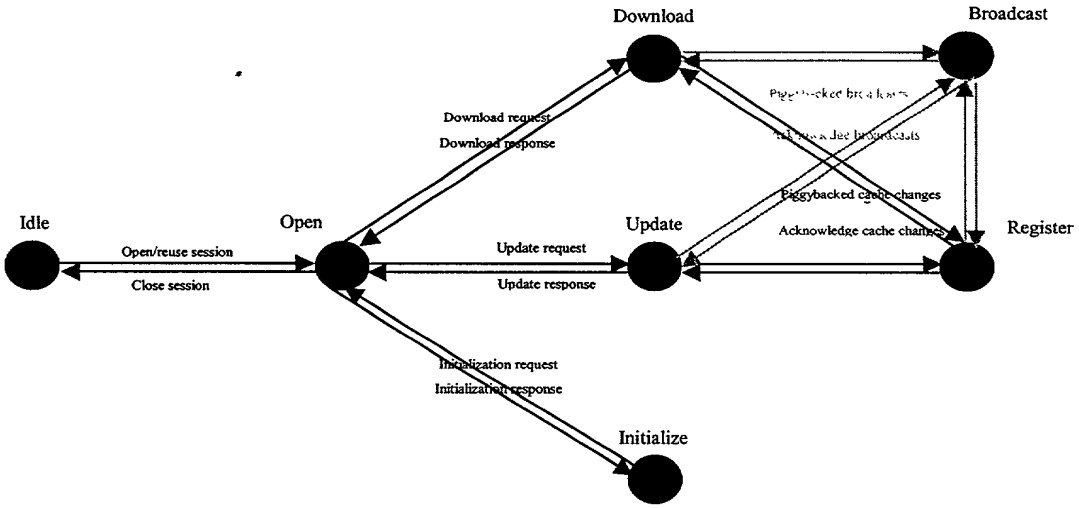
Download
Broadcast
Download request
Download response
Piggybacked broadcasts
Piggybacked cache changes
Acknowledge cache changes
Idle
Open
Update
Register
Open/reuse session
Close session
Update request
Update response
Initialization request
Initialization response
Initialize

FIG. 21